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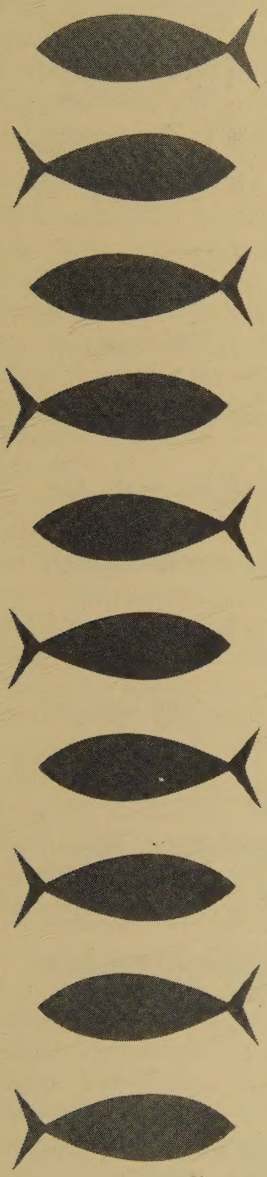
REPORT OF ACTIVITIES First Quarter 1996



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ANTARCTIC ECOSYSTEM RESEARCH GROUP

La Jolla, California

1996 AMLR Field Season Completed

The Antarctic Marine Living Resources (AMLR) Program managed by the Antarctic Ecosystem Research Group (AERG) at the Southwest Fisheries Science Center (SWFSC) in La Jolla, California, has conducted research in the Southern Ocean for eight consecutive austral summers. The AMLR Program advises the U.S. delegation to the Convention for the Conservation of Antarctic Marine Living Resources, which is part of the Antarctic treaty system. A report of the 1996 AMLR field season is presented here.

Cruise Leg I--The chartered research vessel *Yuzhmorgeologiya* departed Punta Arenas January 18, 1996, on the first leg (30 days) of a research cruise to the vicinity of Elephant Island, South Shetland Islands, Antarctica. On January 21, Division Chief Rennie Holt, LTJG William Cobb (AERG), and contractors William Meyer and Brian Walker transferred from the ship to Seal Island, a small island northwest of Elephant Island, for a two-week stay. Because Seal Island is geologically unstable and possibly unsafe due to landslide hazards, land-based research at the field camp was significantly abbreviated this year. In anticipation of moving the land-based research effort to a new site, the field team disassembled one of the existing structures and removed the materials from the island. During their stay, the team also made counts of chinstrap (*Pygoscelis antarctica*) and macaroni (*Eudyptes chrysolophus*) penguin chicks at selected colonies, weighed Antarctic fur seal (*Arctocephalus gazella*) pups, and recorded sightings of previously banded penguins and seals. Results revealed lower chick production for both species of penguins as compared to previous years, while fur seal pup weights were heavier than those measured last year.

After departing Seal Island, acoustic data and four krill samples were collected along transects entering and leaving Admiralty Bay, King George Island, to characterize Antarctic krill (*Euphausia superba*) distribution and demography. Results of these observations were given to personnel (sponsored by the National Science Foundation) at the nearby Copacabana field camp to complement their studies of the diets of Adelie (*Pygoscelis adeliae*), chinstrap, and gentoo (*P. papua*) penguins. Preliminary examination of the data on diet suggested the birds were selectively foraging on large krill.

From January 23 through February 4, a large-area survey was conducted to map meso-scale (10's to 100's of kilometers) features of water mass structure, phytoplankton biomass and productivity, and zooplankton constituents (krill and others) in the area around Elephant Island, Clarence Island, and the eastern end of King George Island (Fig. 1). The survey consisted of 91 conductivity-temperature-depth (CTD) and net sampling stations, spaced along 1365 nautical miles (nmi) of acoustic transects. Bioacoustic analyses during the transects were conducted to monitor krill and other zooplankton. Operations at each station included measurements of the physical characteristics of the ocean environment and sampling of krill and other zooplankton.

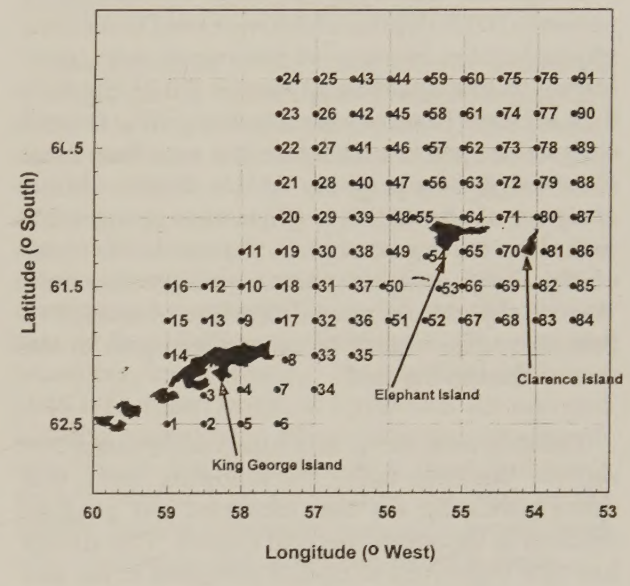

Figure 1. Map showing locations of 91 stations sampled during the Antarctic Marine Living Resources large-area survey.

Krill were found at all but two of the 91 survey stations. Mean krill abundance was more than eight times greater than that observed during a similar survey conducted last year during this time period. Two age-maturity classes dominated the samples as determined from size measurements: juveniles (22-33 mm, 1-year-old krill) and mature adults (44-53 mm, 4 years and older). The juveniles were by far the largest component, contributing 63% of the total abundance; mature forms comprised 22% and intermediate stages (2 and 3 years old) made up only 14% of the total. The relatively large proportions of 1-year-old krill indicate good recruitment success

resulting from the 1994/95 spawning season. This is in strong contrast to the 1992/93 and 1993/94 seasons which had very poor recruitment, as shown by the low proportions of intermediate stages of krill. Salps (*Salpa thompsoni*) occurred in two-thirds of the large-area survey stations. Mean salp abundances were similar to last year at this time, but quite low relative to those observed during 1993 and 1994. Both strong krill recruitment success and relatively low summer salp abundance followed extensive sea ice cover in the Antarctic Peninsula region during winter 1995. These observations support the hypothesized associations among krill recruitment, and salp population size and winter sea-ice conditions published by AMLR collaborators Volker Siegel (Institute for Sea Fisheries) and Valerie Loeb (Moss Landing Marine Laboratories).

Integrated chlorophyll-*a* (*chl-a)* concentrations (down to 100 m depth), which were used to estimate phytoplankton biomass in the survey area, were higher in Bransfield Strait waters (10-35 mg m^{-2}) than in Drake Passage waters (<10 mg m^{-2}). Overall chl-*a* values were much lower this year than those observed during previous AMLR studies. Initial analyses of the survey's physical oceanographic data show surface conditions were cool over much of the study area but were warmer in the east. Water temperatures ranged between 0.4 and 2.5°C. Salinities were higher in the western part of the survey than in the east.

The ship returned to Seal Island on February 5 to recover the field team; the following week was spent surveying fur seal rookeries and penguin colonies in the South Shetland Islands. This survey had two objectives: to update estimates of fur seal pup production and to investigate potential sites for a new field camp. Primary criteria for a campsite include access to penguin colonies and fur seal rookeries, a protected site for structures with minimal impact on animals, a water source, and a good beach landing area for delivery of personnel and supplies by small boat. The Chilean field camp at Cape Sheriff on the north side of Livingston Island was visited during the site survey. A lead scientist at the Chilean camp, Daniel Torres, was enthusiastic about the possibility of a joint U.S.-Chile effort at Cape Sheriff. Other locations visited during the camp-site survey were unsuitable. Following the site survey, Holt, Cobb, and AERG Fishery Biologist Wesley Armstrong returned to Seal Island for a final 10-day stay. The ship returned to Punta Arenas on February 16.

Cruise Leg II--The ship departed Punta Arenas for the second leg of the research cruise on February 19, 1996 to pick up the field team. In addition to conducting fur seal pup counts and identifying banded seals and penguins at Seal Island, the field team had spent considerable time weighing and measuring penguin chicks as the chicks left their colonies and went to sea for the first time, an event known as fledging. The data collected provided information on penguin chick condition, availability of the main food source (krill) to the parent penguins, and parental success in providing food to the chicks.

A large-area survey was begun on February 23; this survey was a replicate of that conducted on Leg I (Fig. 1). The acoustic data revealed krill distributions generally consistent with those of Leg I: dense aggregations to the northwest of Elephant and King George Islands, to the northeast of Clarence Island, and between Elephant and King George Islands.

While krill distribution (as measured acoustically) appeared similar to Leg I, demographics and abundance differed. Results of the large-area zooplankton net sampling indicated changes in abundance and maturity stage composition of krill and other components compared to the previous leg. The frequency of occurrence of post-larval krill was lower during the Leg II survey compared to Leg I. Although the overall mean abundance estimates for the two surveys were similar (107 krill per 1000 m^3 for Leg I and 112 krill per 1000 m^3 for Leg II), this was primarily due to an extremely large catch at station 80 just north of Clarence Island (7,385 krill per 1000 m^3). The median krill abundance during the Leg II survey (3.3 krill per 1000 m^3) was approximately 25% of that during the Leg I survey, with large mature males dominating the catches (73%). Two age-maturity classes again were dominant in the catches, but during Leg II the smaller stages were relatively less abundant. Omitting the large catch at station 80 (almost exclusively large, mature krill), juveniles and immature males (1 year old, <34 mm in length) made up only 23% of the total. The distribution of these stages was limited to the areas south and west of Elephant Island. These results contrast markedly with the Leg I survey, during which small (1-year-old) stages comprised the largest part of the catch and were broadly distributed across the southern and central portions of the survey area. Virtually all of the large females were in advanced maturity stages; 58% were gravid and 22% were spent. Larval stages of krill were more

frequent and abundant during the Leg II survey than during Leg I, reflecting a seasonal progression in spawning intensity and larval development.

Salps were encountered with similar frequency during both surveys: 57% of the samples on Leg II and 59% on Leg I. While the mean abundance values were also similar for the two surveys (28 salps per 1000 m^3 on Leg II and 20 salps per 1000 m^3 on Leg I), the median catch during the Leg II survey (0.9 salps per 1000 m^3) was substantially lower than that on Leg I (4 salps per 1000 m^3). Among the non-krill zooplankton, abundances of copepods and chaetognaths substantially increased from Leg I to Leg II, whereas pteropod abundances decreased.

Preliminary analyses from the survey's physical oceanography studies revealed sea surface temperatures were 0.5 °C warmer on Leg II compared to the first leg survey. Sea surface temperatures were not below freezing at any of the survey stations during Leg II. Phytoplankton studies provided integrated chl-*a* values (down to 100m depth) of <20 mg m^{-2} in Drake Passage waters and 30-50 mg m^{-2} in the rest of the survey area, with the exception of patches of high biomass (>80 mg m^{-2}) to the east of King George Island and to the south of Elephant and Clarence Islands.

During the last week of Leg II, transects were made across the continental shelf break north of King George Island, and north and south of Elephant Island. CTD stations were conducted along the transects during nighttime hours to investigate water mass structure across the shelf. Directed net sampling was accomplished during daytime hours to sample discrete layers in the water column for zooplankton detected using the acoustic system. The researchers collected both volume backscattering (Sv) and individual target strength (TS) acoustic data. The purpose of these studies was to correlate the TS and Sv acoustic measurements with species and length data obtained from the zooplankton (krill and others) collected in the net samples.

Leg II was completed March 18, 1996, when *Yuzhmorgeologiya* returned to Punta Arenas, bringing to a close the 1996 AMLR field season in the Antarctic. Although the use of a chartered vessel for the first time had presented many logistical challenges, all scientific objectives were accomplished and the field season was a great success. (J. Martin, [619] 546-5600)

COASTAL FISHERIES RESOURCES DIVISION

La Jolla, California

Recovering Pacific Sardine Found to Mature Earlier and have Faster Growth

Fishery Biologist John Butler completed cooperative research on the age, growth, and maturation of Pacific sardine with colleagues Maria Louisa Granados G. from Instituto Nacional de Pesca, Mexico, Tom Barnes and Marci Yeremko from California Department of Fish and Game, and Research Fishery Biologist Beverly J. Macewicz of SWFSC. The research was a part of work producing the daily egg production biomass (DEPB) estimate for the transboundary stock of Pacific sardine.

The objectives of the study were to determine whether current somatic growth rates were similar to those found previously and to determine at what age the sardines were beginning to spawn. During the 1994 DEPB survey, samples were taken from Monterey to southern Baja California in the most comprehensive study of regional growth of the Pacific sardine to date. In this study, age 1 fish, which are about 10 months old, averaged 142, 162, and 146 mm in Baja California, Southern California, and Monterey, respectively. During 1934-1943 and 1944-1957, mean length at 1 year was 101 mm and 131 mm, respectively. These differences in growth rate may be due to differences in the population's present size and its size during the peak of the fishery. Similar differences in sardine growth rates with population size have been found in Japan.

Ages of adult sardine in 1994 ranged from 1 to 7 years. Very few fish were older than 4 years, and most of the biomass was in the more recent year classes. This age composition of Pacific sardine reflects a growing population and high adult mortality rates.

Scientists also revealed that some individuals mature before their first birthday and that maturation of Pacific sardine appears to vary with latitude. Sardines in the south mature at a younger age than in the north. Most sardines in the current population mature at age 1, rather than at age 2 as reported for the population prior to the collapse of the fishery. The fast growth rates of young fish and the early maturation may be contributing factors to the resurgence of the Pacific sardine population. (J. Butler, [619] 546-7192)

MARINE MAMMAL DIVISION

La Jolla, California

POPULATION IDENTITY PROGRAM

Marine Mammal Genetics Volume Accepted for Publication

A collection of papers on marine mammal genetics from a meeting held in September 1994 at the SWFSC in La Jolla, California, was accepted for publication as a NOAA Technical Report. The title of the volume is "Molecular genetics of marine mammals: incorporating the proceedings of a workshop on the analysis of genetic data to address problems of stock identity as related to management of marine mammals." Edited by SWFSC scientists Andrew E. Dizon, Susan J. Chivers, and William F. Perrin, the volume is a collection of papers from a two-day symposium on general marine mammal genetics topics attended by more than 200 people and an invited workshop of 50 participants. The rapid and continuing development of molecular genetic tools promises new avenues for understanding population structure. A focus of this workshop was to develop ways to use the new information to guide management decisions.

For example, when a particular investigator finds positive evidence of population subdivision, managers can be confident the stocks are separate; that is, the exchange rates between the stocks are virtually nil. What happens if a study fails to find evidence of subdivision? Even very low levels of interchange, for example a few dispersers a year, can preclude detection of a statistically significant subdivision. On the other hand what seems to be an insignificant amount of mixing to a manager (for example, 10 individuals per year) can be sufficient to make genetic differences between very small populations. This results in low statistical power for many genetic studies, especially those dealing with large populations. It is distressingly common that authors will recommend pooling putative subpopulations because of failure to find significant population subdivision. Because of the inherent low statistical power, the likelihood of committing a type II error, that is, accepting a false null hypothesis, is very high.

Another related issue is the necessity of presenting genetic data in ways useful for making conservation decisions. A "stock" is a human construct defined by specific management objectives. For marine mammals, an understanding of dispersal rates between different areas allows better management of localized fishery-caused mortalities. The question is what group of animals is being affected by a fishery and can respond to the impact. It is unlikely, for example, that animals in Alaska would be recruited into an area in California where fishery mortality exceeds local recruitment. The challenge for geneticists is to provide the estimates of dispersal to determine the stock boundaries and hence how many animals are available to the fishery.

These very real problems for the conservation of marine mammals, imposed by the presence of intraspecific structure that is difficult to determine and anthropogenic mortality that is unequally distributed across the species range, provided the focus of the workshop following the general symposium. The primary goals of the workshop were to review how knowledge (or the lack of it) of intraspecific structure affects the management of a variety of species and species groups and to address the question of how specific molecular genetic data can be used in the management of marine mammals.

The goals, discussions, deliberations, and recommendations of the workshop are described in the volume. Also included in this volume are 22 papers, including reviews of a variety of management-sensitive species and species-groups and descriptions of studies of specific ways in which molecular data can be linked with the conservation decision process. The latter studies should provide an impetus for future work so that the explosive progress in molecular biology can be efficiently employed in the service of present and future conservation problems. (A. Dizon, [619] 546-7089)

1995 Stock Assessment Cruise for Harbor Porpoise Completed

A census and stock assessment cruise for harbor porpoise (*Phocoena phocoena*) conducted aboard the NOAA research vessel *McArthur* was completed December 5, 1995. The cruise was a joint project between the SWFSC and the National Marine Mammal Laboratory under the leadership of Biologist Barbara Taylor.

The vessel departed San Diego, California, November 13, 1995, and transited to the starting point at Pt. Conception, California. The main objectives of the project were to estimate harbor porpoise abundance and distribution by water depth and to collect biopsy samples to assess stock structure of harbor porpoise along the west coast of the

continental United States. The latter objective consisted of a pilot study on biopsy techniques for harbor porpoise in areas where the animals are unattainable from strandings. Data on the density, size, and species composition of all cetaceans encountered in the study area were also collected.

The project was designed to cover waters off California, Oregon, and Washington; however, due to weather and logistic constraints, the principal study area was limited to the coast of California between Pt. Conception and the California-Oregon border. Survey operations were conducted along predetermined cruise tracks. Dedicated biopsy collection from harbor porpoise was only possible one day in Monterey Bay and one morning south of Cape Mendocino.

Oceanographic data, including sea temperature (surface and depth profiles), salinity, and surface fluorescence were collected; photographs were taken for use in photo-identification of individual whales; and tissue samples for subsequent genetic analysis were obtained from marine mammals using projectile biopsy techniques.

A total of 280 harbor porpoise sightings were made (Table 1), 259 within the California study area. Approximately 78% of the proposed tracklines were completed in California waters. Kilometers of effort are given in Table 2 with days outside the study area denoted with an asterisk.

Certain differences in survey methods and conditions among cruises should be noted. From Table 3, it can be seen that Beaufort sea states were higher during this survey than during past ship surveys; however, this was the first ship survey at different depths, including deeper waters where sea conditions are often poor. Previous surveys primarily were done only along the 10-fathom isobath. Although calmer conditions often prevail in shallower waters near the coast, making animals more visible, abundance estimates from prior surveys were based on a rather crude model of how animals were expected to be distributed with depth. This was done to compensate for having surveyed only at one depth. Additionally, one prior survey (April 1986) was conducted primarily in Monterey Bay, where conditions were suitable for concurrent aerial observations of harbor porpoise behavior. Another important difference is that the major surveys in

Table 1. Marine Mammal Sighting Record: Number of schools sighted for different species on the 1995 harbor porpoise survey.[1]

Species Name of Sighted Animals	Pure Schools	Mixed Schools	Total Schools	Average School Size
Harbor porpoise (*Phocoena phocoena)*	280	0	280	2.3
Dall's porpoise (*P. dalli)*	42	0	42	5.4
Common dolphin (*Delphinus delphis)* (unidentified subspecies)	2	0	2	300
Common dolphin (*D. delphis*) (long-beak)	1	0	1	300
Pacific white-sided dolphin (*Lagenorhynchus obliquidens)*	6	1	7	138.3
Northern right whale dolphin (*Lissodelphis borealis)*	1	1	2	37.3
Gray whale (*Eschrichtius robustus)*	3	0	3	2.3
Baleen whale (*Balaenoptera* spp.)	1	0	1	2
Mink whale (*B. acutorostrata)*	2	0	2	1
Fin whale (*B. physalus)*	1	0	1	1
Blue whale (*B. musculus)*	5	0	5	2
Humpback whale (*Megaptera novaeangliae)*	6	0	6	1.2
unidentified dolphin	8	0	8	33
unidentified small whale	2	0	2	3.5
unidentified cetacean	3	0	3	2.3
unidentified whale	5	0	5	1.4

[1]To maximize the chance of sighting harbor porpoise, observers had to focus their attention closer to the vessel than in surveys designed for large whales and schooling dolphins. For this reason, sightings for other marine mammals are not directly comparable with other surveys and used for information on distribution only.

September 1984 and April 1986 completely missed the area around Cape Mendocino, which yielded the highest density of porpoise within California during this survey and aerial surveys from 1986-1993.

Table 2. Kilometers of Effort Record: Number of kilometers of survey effort for each day, during daylight hours. Note that transit days and days on furlough are omitted and that asterisks denote days outside the California study area.

Date	Kilometers of Effort	Date	Kilometers of Effort
14 Nov 95	146.1	23 Nov 95	114.8
15 Nov 95	97.8	25 Nov 95	97.8
16 Nov 95	84	26 Nov 95	135.5
17 Nov 95	33	27 Nov 95	162.4
20 Nov 95*	131.7	28 Nov 95	158.8
21 Nov 95*	31.7	29 Nov 95	90.3
22 Nov 95	124.5	30 Nov 95	69.4

Table 3. Comparative Sea States: Percentage of searching effort in various sea states for harbor porpoise cruises.

Beaufort sea state	Cruise date				
	Sept. 1984	Jan. 1985	Sept. 1985	April 1986	Nov. 1995
0	1.6	2.0	0.0	0.5	3.0
1	26.1	36.7	31.5	53.0	10.7
2	38.3	30.9	45.6	23.0	31.0
3	18.9	18.6	12.7	16.5	25.6
4	9.2	9.0	8.0	6.5	18.3
5	5.9	2.7	1.8	0.5	11.4
≤2	66.0	69.6	77.1	76.5	44.7

Preliminary analyses of depth data for the 1995 cruise indicate harbor porpoise prefer waters from 20 to 60 m in depth, with a notable dearth of animals in waters deeper than 80 m. Results of an analysis of all days within the California study area caused researchers to reject the null hypothesis of random distribution with depth with high significance (p = 1.28 e-11, Kolmogorov-Smirnov test). Because distance offshore is correlated with both depth and (probably) the Beaufort sea state, the data were stratified by Beaufort state and the above conclusions held with all p-values . These preliminary analyses used the bottom depth recorded from the ship at the time porpoise were sighted and will need to be corrected for the depth at the porpoise location in the future. Results are expected to differ little because most porpoise are sighted within a few hundred meters of the ship. Previous estimates of abundance that relied on several hypothetical models of porpoise distribution with depth can be improved using these data.

Biopsy tissue samples were obtained from two harbor porpoise and from other small cetacean species during the cruise (Table 4). Biopsy sampling of harbor porpoise has not been previously attempted because the animals are both elusive and small. Obtaining samples requires optimal calm sea conditions and waiting for the animals to approach within range (20-40 feet). Researchers chose high-density areas to increase the chances of porpoise approach; they obtained one sample in Monterey Bay aboard a rigid-hulled inflatable boat and one sample south of Cape Mendocino aboard a small boat. Obtaining porpoise biopsies will always be a time-consuming endeavor but is clearly feasible in areas where samples by other means are unavailable. (B. Taylor, [619] 546-5620)

Table 4. Biopsy Sample Record: Biopsy samples collected on 1995 harbor porpoise cruise.

SPECIES SAMPLED	NUMBER OF BIOPSY SAMPLES
Harbor porpoise	2
Dall's porpoise	10
Pacific white-sided dolphin	2
Northern right whale dolphin	3
Total Number of Biopsies:	17

HONOLULU LABORATORY

Honolulu, Hawaii

FISHERY MANAGEMENT AND PERFORMANCE INVESTIGATION

Preliminary Results of an Analysis of the Hawaii-based Longline Fleet, Fourth Quarter 1995

In the Hawaii-based longline fishery, a total of 96 vessels fished during the fourth quarter 1995, which was an increase over that observed in the third quarter (Fig. 1). This increase resulted largely from the seasonal demand for sashimi-grade tuna. Of the

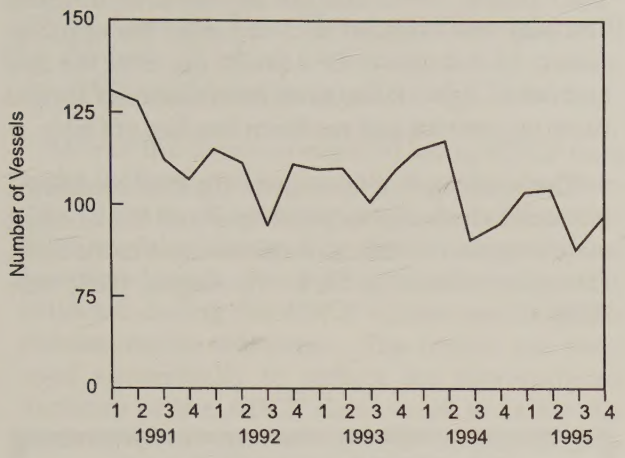

Figure 1. Number of Hawaii-based longline vessels by quarter, 1991-95 (based on haul dates).

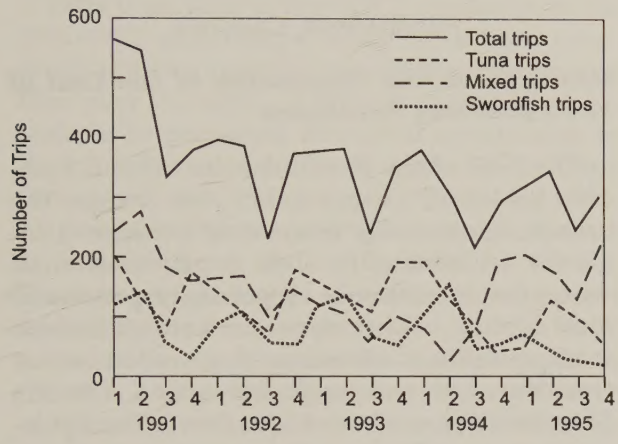

Figure 2. Total number of trips and trips by target species for the Hawaii-based longline fleet by quarter, 1991-95.

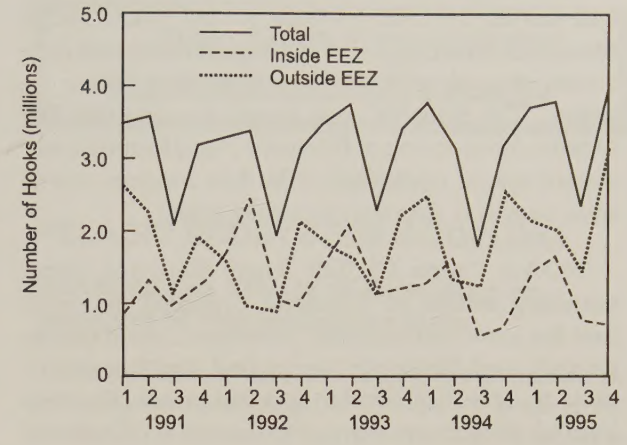

Figure 3. Number of hooks set by area and quarter for the Hawaii-based longline fleet, 1991-95.

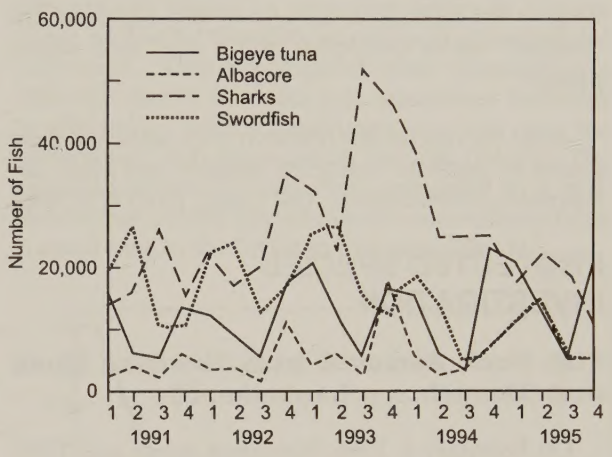

Figure 4. Catch (number of fish) of the Hawaii-based longline fleet by quarter, 1991-95.

308 trips made during the fourth quarter, 228 of the trips targeted tuna, 61 targeted mixed species, and 19 targeted swordfish (Fig. 2).

A record 3.9 million hooks were set, with effort inside the Hawaii Exclusive Economic Zone (EEZ) increasing slightly and effort outside the EEZ decreasing over the previous quarter, as has been the trend over the past 4 years (Fig. 3). Over four and a half times as many hooks were set by the Hawaii-based fleet within the EEZ (3.2 million hooks) as were set outside (0.7 million hooks).

The largest component of the fourth quarter 1995 catch was bigeye tuna (*Thunnus obesus*, $N = 20,362$), followed by albacore (*T. alalunga*; $N = 16,187$) (Fig. 4). High catches of bigeye tuna and albacore have been recorded since 1991. Catches of sharks ($N = 10,377$) and swordfish ($N = 4,834$) have decreased since 1993 and were again low during this quarter. (R. Y. Ito, [808] 943-1213)

FISH BIOLOGY AND ECOLOGY INVESTIGATION

Research Scientists and NOAA Corps Perform At-sea Rescue

The crew and scientists of the NOAA research vessel *Townsend Cromwell* dropped their swordfish sampling work in February to save two injured fishermen and four others aboard the sinking fishing vessel *Red October*. The rescue occurred 550 miles northeast of Honolulu.

At midnight on February 6, 1996, *Townsend Cromwell* started the hunt for *Red October* under rough seas, after receiving a distress report of injured fishermen aboard a 75-foot boat that was taking on water. The research crew found the crippled *Red October* the morning of February 7 and immediately started rescue operations. The first concern was to save lives and stop the oncoming water.

NOAA Corps LTCDR Rusty Brainard, commanding officer of *Townsend Cromwell*, reported that the crew and scientific party performed courageously and flawlessly under bad weather conditions to save *Red October* and her crew. The two injured fishermen were transferred to *Townsend Cromwell* in stable condition, received medical attention, and were returned to *Red October* the next day in good condition. The NOAA crew also transferred drinking water, food, dry clothes, and bedding to the other four fishermen and repaired *Red October's* leaky propeller shaft area and water pumps.

After the rescue, the research crew resumed their cruise to perform biological studies and stock assessments of swordfish. (M. Laurs, [808] 973-2946)

PROTECTED SPECIES INVESTIGATION

Fish Hook Removed from Hawaiian Monk Seal (*Monachus schauinslandi*)

On February 4, 1996, Hawaiian monk seal TY55 hauled out on Ala Moana Beach in Honolulu with a large fish hook embedded in its mouth. The hook was the type used by recreational fishermen fishing from the shore for ulua, a prized sport fish in Hawaii. This adult male seal had been translocated from Laysan Island in 1994 and subsequently observed throughout the main Hawaiian Islands. Several sightings in December 1995 and January 1996 indicated the seal had been hooked.

Lifeguards cordoned off the area where the seal hauled out and contacted state officials, who alerted biologists of the Marine Mammal Research Program, the enforcement office of the National Marine Fisheries Service (NMFS), and the University of Hawaii's Joint Institute for Marine and Atmospheric Research. A capture team was formed,including a representative of the NMFS Observer Program, who happened to be at the beach that day. The seal was netted and sedated with valium, and the hook was successfully removed from the animal's mouth, which did not appear to be infected. The seal was released and observed for approximately 15 minutes until it swam out over the reef and out of sight. It has since been observed several times on western and northern beaches of Oahu.

The hooking of this seal was the first confirmed interaction between local fisheries and the 21 adult male Hawaiian monk seals translocated to the main Hawaiian Islands in 1994. (T. Ragen, [808] 943-1280)

PACIFIC FISHERIES ENVIRONMENTAL GROUP

Pacific Grove, California

Research on the Circulation of the Gulf of the Farallones Continues

The Gulf of the Farallones lies off San Francisco between Pt. Reyes and Pt. Año Nuevo. The area is dynamically interesting because it includes an unusually wide continental shelf where the circulation is especially responsive to local forcing. Other dynamic features include local upwelling, advection of upwelled waters from the north and south, interaction with San Francisco Bay, and broad equatorward and poleward flows offshore. Research is being conducted at PFEG to define and understand the principal features of the circulation on the shelf and slope and relate these features to the fishery environment. For example, the gulf is a major spawning ground, and successful recruitment may depend on how and where larvae are transported within the circulation. Also, the gulf has been and remains an important dumping site for material dredged from San Francisco Bay. Studying the circulation may help the Environmental Protection Agency (EPA) choose appropriate sites for dumping and may reveal if and where these materials will migrate.

Data sets collected in recent years will be used in this analysis of the gulf, including Tiburon Laboratory rockfish surveys, an EPA and Office of Naval Research-sponsored slope/shelf field study, Navy cruises aboard the Navy ship *DeSteiger* and research vessel *Pt. Sur*, and current meter moorings from several previous field pro-

grams. Data sets from 27 cruises in the region will be studied, 15 of which included high-quality acousticDopplercurrentprofiler(ADCP)data.

One of the disadvantages of using ADCP data is the difficulty of separating the tidal and subtidal signals. A spatially dependent, baroclinic tidal model of the gulf has been created by researchers based upon the empirical velocity data collected during the ADCP cruises and from the current meter moorings. The model has been used successfully to reduce the tidal-induced variance of the ADCP data; work to refine the model to better characterize the complex tides in the region continues. Initial results of this work were presented at the September 1995 Eastern Pacific Oceanic Conference.

Data from four of the ADCP cruises from the 1991-1992 shelf/slope study have been processed and examined for variability in poleward flow over the slope. Although more cruises remain to be examined, the initial results seem to show that poleward flow is seen over the slope throughout the year (February 1991, May 1991, August 1991, February 1992) from the surface to at least the depth limit of the ADCP (~400 m). There is a high degree of spatial and temporal variability in the poleward flow, but no clear seasonal or topographically trapped signal is present. Poleward flow was somewhat stronger in February 1992, when the oceanic El Niño signal reached the central California coast. These results were presented in a poster at the February 1996 Ocean Sciences Conference in San Diego, California.

In the next few months, the remaining ADCP cruises will be processed and all the data "detided." The flow fields, transports, and their seasonal, annual, and interannual variability will be calculated. The flows from the ADCP data will be compared to the flows derived from conductivity-temperature-depth measurements and observed at the current meter moorings. Water mass characteristics, their fluxes, and their relationships to the flow patterns will be investigated.

The bulk of this work is being performed on the PFEG IT-95 server and Unix work station. A large database of central California oceanographic data is being assembled on the server to facilitate studies of this kind. (J. Steger, [408] 648-9035)

PELAGIC FISHERIES RESOURCES DIVISION

La Jolla, California

PELAGIC ECOSYSTEM MODELING

Modeling the Effects of Schooling on Analyses of Tag-Recapture Data

Pierre Kleiber, fishery biologist, has continued an investigation modeling the effects of schooling behavior on analyses of tag return data when, as is almost always the case, the analytical models do not account for schooling behavior. As of the previous quarter, a simple movement model showed that estimates of diffusion and advection parameters are not biased by schooling behavior but are more imprecise than they would be if schooling did not occur. That investigation was extended to a different model in which fish movement behavior is affected by habitat conditions—in this case, the presence of fish aggregation devices (FADs). The required parameters are now embodied in a submodel that relates the tendency to move away from a small area to the FADs in that area (Fig. 1).

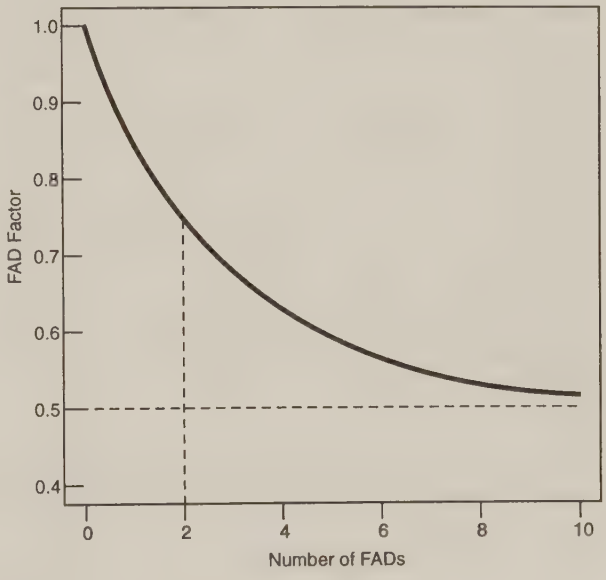

Figure 1. FAD effect submodel. The number of FADs in a spatial cell determines a multiplicative factor that alters the proportion of animals moving out of the cell in one time step. Cells with no FADs have no effect (FAD factor = 1), but with increasing numbers of FADs, the effect increases (FAD factor decreases) and approaches a saturation level (*Sat*). The parameter, f_h, is the number of FADs in a cell that gives half the saturation effect.

As before, parameter values were estimated from 200 sets of synthetic data from non-schooling fish and 200 sets from schooling fish, in both cases using a non-schooling analytical model. Synthetic data were produced with a movement model operating on a 19 by 23 cell spatial grid. Four of the grid cells contained differing numbers of FADs. Tags were released in each of those four cells. Fishing effort was assumed to be distributed throughout the grid.

As with the previous investigation, tag data from non-schooling fish readily produced estimates of movement and mortality parameters (Table 1). Also, schooling fish produced reasonable estimates of mortality parameters with the non-schooling analytical model. However, for the movement parameters, the estimates from schooling fish were highly variable, and in the case of the saturation parameter the estimate appears very biased (Table 1). What appears to be happening in the latter case is that happenstance movement of schools can result in many of the grid cells being unvisited by tagged fish. With FADs in only four cells, it is likely that one or more FAD densities will not be represented in the data, with the result that the relationship between FAD density and movement will be poorly defined.

This investigation will continue, but a lesson already evident is that a tag experiment, the purpose of which is to reveal the relationship between movement and features of the habitat, relies on the tagged fish moving throughout a representative range of habitat variation. If the tagged fish do not adequately "sample" the habitat, then the resulting information will be inadequate. Further tests with different distributions of FADs are underway. (P. Kleiber, [619] 546 7076)

TIBURON LABORATORY

Tiburon, California

FISHERY MANAGEMENT ADVISORY

Metal Concentrations in Juvenile Chinook Salmon Examined in the San Francisco Estuary

Metal contamination in the drainage basin into San Francisco Bay has produced toxic effects and ecological consequences and has evoked human health advisories for consumption of fish caught in the San Francisco Bay estuary. For example, embryonic abnormalities or teratogenic effects (malformations) have been associated with elevated selenium concentrations in waterfowl, and high levels of mercury in striped bass have resulted in state-issued advisories against fish consumption. These considerations, in combination with the desire to identify potentially influential environmental factors, caused researchers in the Physiological Ecology Investigation to include trace metal analysis in their study of the physiological ecology of juvenile, fall-run chinook salmon *(Oncorhynchus tshawytscha)* as the salmon transit the San Francisco estuary during their journey to the ocean.

A portion of the juvenile salmon collected during April to June 1995 was analyzed for a suite of trace metals. Fish were obtained at locations spanning their estuarine outmigrating pathway, from the western delta at Chipps Island (the most freshwater, upstream site) to central San Francisco Bay. Additionally, hatchery-reared juveniles were assayed for comparison. Specimen collections were made by two sweeps of the estuary, to better characterize temporal variability encountered by the entire juvenile population. To improve accuracy and increase

Table 1. Mean values, medians, and 95% confidence ranges of parameter estimates from a non-schooling model used to analyze synthetic data consisting of 200 non-schooling data sets and 200 schooling data sets. "Real values" are the parameter values used to create the synthetic data.

Parameter	Real Value	Non-schooling			Schooling		
		mean	median	range	mean	median	range
Diffusion	2.0	2.02	2.01	1.7-2.4	2.31	2.00	1.0-4.9
Saturation	0.5	0.50	0.50	0.35-0.72	1.01	0.56	0.0-5.3
FADs at half Saturation	2.0	2.00	2.0	1.9-2.1	2.23	2.06	0.2-5.3
Natural Mortality	0.2	0.20	0.20	0.18-0.23	0.20	0.20	0.17-0.23
Fishing Mortality	0.1	0.10	0.10	0.09-0.11	0.10	0.10	0.08-0.11

the number of fish analyzed cost-effectively, each metal sample consisted of a composite of six salmon. Whole bodies, except stomach contents, were digested with a nitric-perchloric acid mixture and analyzed for silver, aluminum, cadmium, chromium, copper, mercury, magnesium, nickel, lead, selenium, and zinc by atomic absorption spectrophotometry using ultra-clean techniques at the California Department of Fish and Game's trace metal facility.

On the basis of an analysis of variance, researchers indicated there were significant differences by capture location in the concentrations of many metals in juvenile salmon (Table 1). Levels of several metals (aluminum, magnesium, cadmium, copper, selenium) were elevated in fish caught at Chipps Island or in San Francisco Bay compared to hatchery-raised salmon. Furthermore, copper and zinc concentrations were significantly greater in fish from San Francisco Bay than those collected at the head of the estuary at Chipps Island. This suggests there may be significant sources of these metals within the estuary, although zinc was also elevated in tissues of hatchery salmon. Cadmium showed a reverse trend, with the highest concentrations found in fish entering the estuary at Chipps Island.

Table 1. Metal concentrations in juvenile fall-run chinook salmon at locations within the San Francisco estuary during April to June 1995. Values are means (standard error) for 10 composite samples in microgram per gram (µg/g) wet weight. Each composite contained six fish.

Metal	Chipps Island	San Francisco Bay	Hatchery
Aluminum	6.200 (0.78) †	5.310 (0.90) †	0.560 (0.08)
Cadmium	0.016 (0.001)†*	0.012 (0.001)†	0.006 (0.001)
Chromium	0.229 (0.047)	0.172 (0.026)	0.367 (0.103)
Copper	0.499 (0.011)	0.589 (0.034)†¶	0.473 (0.023)
Lead	0.020 (0.001)	not detected	0.020 (0.001)
Magnesium	2.280 (0.23) †*	1.620 (0.19) †	0.937 (0.045)
Mercury	0.051 (0.003)	0.051 (0.002)	0.046 (0.002)
Nickel	0.194 (0.042)	0.170 (0.019)	0.334 (0.114)
Selenium	0.170 (0.010)	0.175 (0.011)†	0.139 (0.011)
Silver	0.002 (0.001)	0.003 (0.001)	0.002 (0.001)
Zinc	31.300 (0.47)	38.200 (1.6)¶	39.400 (1.0)¶

† Significantly greater than Hatchery salmon ($P<0.0001$))

* Significantly greater than San Francisco Bay salmon ($P<0.0001$)

¶ Significantly greater than Chipps Island salmon ($P<0.0001$)

Although robust criteria for aquatic life safety for all metal contaminants are lacking, all the metal concentrations found in this study were below the 1973 recommended guidelines for predator protection by the National Academy of Sciences or action levels for the protection of human health by the U.S. Food and Drug Administration in 1984 and Median International Health Standards in 1988. It should be noted that these data were for metal concentrations in fish tissues during a very wet year with high freshwater outflow (1995). Other researchers have consistently found that periods of high outflow result in lower environmental trace metal levels and, therefore, lower bioaccumulation. This relationship may be operative here; in future years researchers may elucidate the relationship between outflow and metal levels in juvenile, outmigrating salmon.

These data represent only the first year of a proposed three- to five-year study and provide little insight into environmental influences on metal accumulation or the potential impacts of metals on juvenile salmon. But to the researchers' knowledge, these are the first comprehensive data on metal levels in juvenile salmon in the San Francisco estuary. (B. MacFarlane, [415] 435-3149)

GROUNDFISH ANALYSIS INVESTIGATION

First San Francisco Deep Ocean Disposal Site Survey Completed

Fishery biologists of the Groundfish Analysis Investigation, together with scientists from the La Jolla Laboratory and Pacific Fisheries Environmental Group, completed a survey of the San Francisco deep ocean disposal site (SF-DODS). The survey resulted from a request by the U.S. Army Corps of Engineers and the EPA for help in monitoring possible impacts of the disposal of dredged materials on organisms living in the upper water column at the site. Tiburon Laboratory scientists have conducted surveys near this site since 1983. Staff members of the Corps and EPA were aboard the cruise to observe and assist in the operations.

The site is located 23 nmi west of the Farallon Islands in waters more than a mile deep. Contractors for the Port of Oakland's deepening project are scheduled to dispose of 5 million cubic yards of

dredged material at this recently EPA-approved disposal site by the end of September 1996.

Around-the-clock sampling was conducted during the February 26 to March 6, 1996, cruise. Biologists used a Tucker trawl to sample myctophids, large fish larvae, and euphausiids at night and a bongo net during the day to sample smaller fish larvae and invertebrates. The first 48-hour period of sampling at the SF-DODS followed a month-long break from disposal of dredged materials. The vessel then sampled at a "control" site located 25 nmi to the south. Returning to the SF-DODS, the vessel collected samples for an additional day-and-night cycle after four barges disposed dredged materials from the Oakland project. Thirty-two Tucker trawls and 27 bongo tows were completed. As expected, catches were low at the two sites when compared to typical samples taken closer to the shelf during the winter. Catches were dominated volumetrically by salps. The euphausiid *Nematoscelis difficilis* appeared to be the most abundant large zooplankter. The laboratory will contract the Polish Sorting Center and a variety of domestic consultants to conduct most of the sample processing. The resulting data will be analyzed for possible impacts on the abundances and condition of important invertebrates and small fish. The work will emphasize euphausiids, myctophids, and early stages of hake, rockfish, and sanddabs.

Ornithologists participating in the survey observed typical densities of sea birds and marine mammals for winter conditions over off-shelf waters. However, several uncommon species were seen, including a large pod of Risso's dolphins (*Grampus griseus*) stretching for miles. Unusual sightings included a school of albacore chasing bait at the surface, and a swallow-tailed gull, a native species of the Galápagos Islands.

The scientific team also collected data on physical oceanographic variables such as currents, temperature, salinity, primary productivity, and light levels at depth. Sea-surface temperature and salinity ranged from 13-15 °C and 31.6-32.6 ppt, respectively, with warmer temperatures and lower salinities recorded at the control site. Twelve water samples were collected and analyzed for chlorophyll and salinity concentrations. These data were used to calibrate the fluorometer and salinometer data. Cursory analysis revealed anticipated low levels of primary production at the offshore sites. The oceanographic data will aid interpretation of the biological results. (W. Lenarz, [415] 435-3149 ext. 226, and D. Woodbury, [415] 435-3149 ext. 218)

COASTAL COMMUNITIES INVESTIGATION

Study Conducted on the Maturation Process in Lingcod

An unusually high proportion of lingcod (Ophiodon elongatus) landed recently in the commercial and recreational fisheries of Oregon and California have been small fish. This development has emphasized the need to more precisely define size at maturity relationships in this species. Responding to this need, Fishery Biologists Kelly Silberberg and Pete Adams analyzed port sampling data to determine (1) seasonal patterns in maturation of the gonads, (2) proportions of mature and immature fish within different size classes, and (3) size at which 50% of the fish become mature. The analysis was based on recreational and commercial landings in central California, as represented by data collected from 1994 through 1996 by port samplers of the California Department of Fish and Game. These data are limited, but the analysis proceeded for two reasons. First, a 559 mm (22-inch) size limit imposed this year on the commercial catch effectively eliminates this fishery as a future source of data on small, immature fish. Second, data from the recreational fishery are no longer available because the program that sampled these landings was terminated. Although the researchers worked with limited data, their analysis increases scientific understanding of the maturation process in lingcod and makes points significant to effective management of this species.

The maturation of gonads in lingcod involves a series of stages or states that culminate in maximum spawning during December and January. The process follows a temporal pattern that can be seen in specimens collected at different times of the year. Occurrence of maturity stages by month of lingcod ovaries is shown in Figure 1 (there were no samples representing May). Ovaries in a transitional state were noted from June to October and ovaries in a maturing state from June to January. Fully mature ovaries, which occurred first in July, involved an increasing proportion of the samples that peaked in Decem-

ber, then dropped abruptly to a low level in January, with none after that. Spent females occurred first in January and were present until July. Occurrence of various stages of maturation of the testes by month is shown in Figure 2. (There were no samples representing January, February, or May.) Testes in a transitional state were observed from March to November, while fully mature testes, seen first in September, represented a high proportion of the samples in November and December.

The estimates of size at maturity from these data differ significantly from earlier estimates based on lingcod from California. The researchers found that females mature gradually over a broad range of sizes, 437 to 844 mm, and

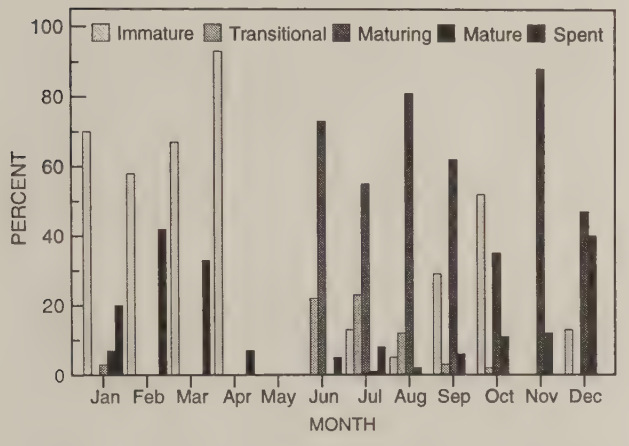

Figure 1. Percent occurrence of female lingcod by maturity stage by month (n = 486).

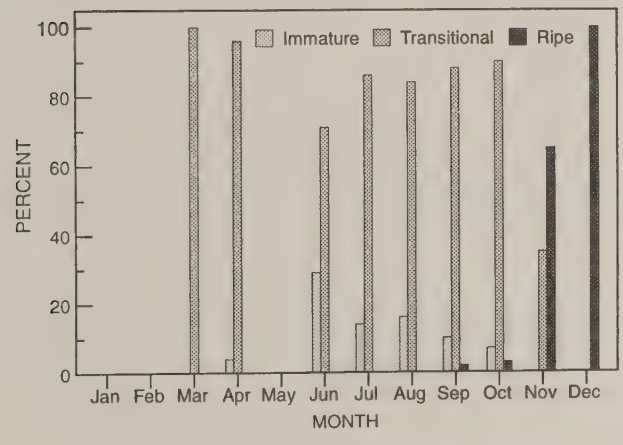

Figure 2. Percent occurrence of male lingcod by maturity stage by month (n = 405).

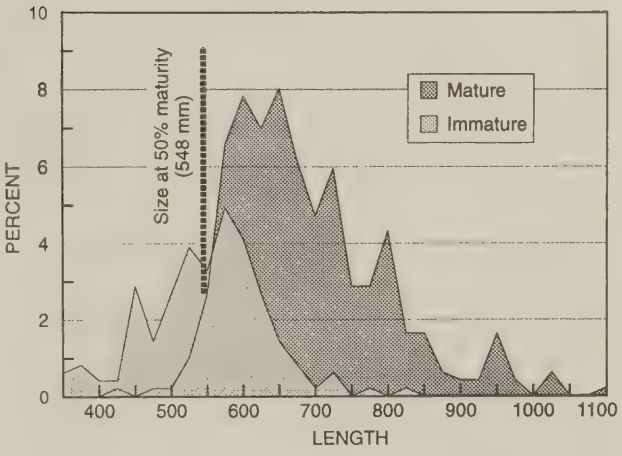

Figure 3. Percent of frequency in each size group of immature and mature female lingcod by size class, with size at 50% maturity.

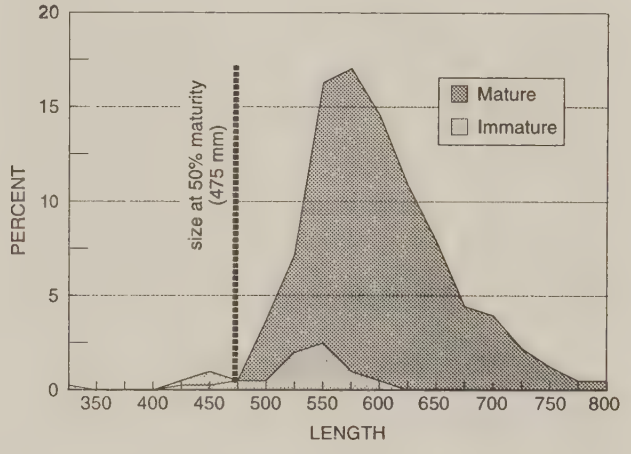

Figure 4. Percent of frequency in each size group of immature and mature male lingcod by size class, with size at 50% maturity.

estimated that 50% are mature at 548 mm (Fig. 3). This is substantially smaller than the earlier estimate of 588 mm. Males were found to mature over a narrow range, 427 to 605 mm, and estimated that 50% are mature at 475 mm (Fig. 4). This is substantially larger than the previous estimate of 424 mm for males from California but agrees with earlier estimates based on fish from Canada and Washington.

If female lingcod off California are now maturing at a smaller size than before, as suggested by the above comparison, the recent trend toward taking smaller fish should be cause for concern. (K. Silberberg and P. Adams [415] 435-3149)

INFORMATION TECHNOLOGY SERVICES

Regional Database Administrators Meet at La Jolla

Information Technology Services chief Rob Bistodeau hosted an NMFS Regional Database Administrators (RDBA) meeting on March 11–13, 1996, at the La Jolla Laboratory. The purpose of the meeting was to discuss national information technology issues and solicit regional suggestions. The meeting focused on how national information technology issues will be handled under the NMFS Information Management Charter Team's recommendations and action plan. The NMFS Transition Board has approved charter team recommendations to (1) establish a national body, the National Information Management Coordinating Committee, to oversee and steer agency-wide information management initiatives and policy; (2) establish ad hoc task teams (temporary or standing) to solve specific problems; and (3) appoint a chief information officer with responsibility for agency-wide coordination, project implementation, and routine oversight of information management operations.

Additional items of discussion at the meeting included charter team implementation plans, data management directives and regulations, systems development, wide-area networking, Internet usage and policies, and the future role of the RDBAs.

The meeting facilitated the closure of the National Data Management Committee made up of the RDBAs. The committee's responsibilities were elevated to the National Information Management Coordinating Committee, which will work with regional staff to create NMFS information management initiatives. Regional assistance will be provided through the new National Information Technology Advisory Committee consisting of NMFS center and region staff. (R. Bistodeau, [619] 546-7055)

PUBLICATIONS

Published

This published list encompasses publications for the calendar year 1995 for the Southwest Fisheries Science Center.

Published in Calendar Year 1995

Adams, P. B., J. H. Butler, C. H. Baxter, T. E. Laidig, K. Dahlin, and W. W. Wakefield. 1995. Population estimates of Pacific coast groundfishes from video transects and swept-area trawls. Fish. Bull., U.S. 93:446-455.

Ainley, D. G., W. J. Sydeman, and J. Norton. 1995. Upper trophic level predators indicate interannual negative and positive anomalies in the California Current food web. Mar. Ecol. Prog. Ser. 118:69-79.

Alvardo, R., V. Arenas, R. Felix-Uraga, R. Fletcher, L. Jacobson, F. Lachica-Bonilla, B. L. Perezgómez, J. P. Pertierra, C. Robinson, and K. V. Shust. 1995. Regional vital rates and movements. *In* J. R. Hunter and J. Alheit (eds.), International GLOBEC Small Pelagic Fishes and Climate Change program. Report of the First Planning Meeting, La Paz, Mexico, June 20-24, 1994, p. 42-52. GLOBEC Report #8. 72 p.

Antezana, T., W. García, J. Hunter, J. Largier, Y. Matsuura, J. Moisan, S. Painting, P. Schlittenhardt, and J. R. Torres. 1995. Enrichment and Concentration Processes. *In* J. R. Hunter and J. Alheit (eds.), International GLOBEC Small Pelagic Fishes and Climate Change program. Report of the First Planning Meeting, La Paz, Mexico, June 20-24, 1994, p. 21-30. GLOBEC Report #8. 72 p.

Balazs, G. H. 1995. Innovative techniques to facilitate field studies of the green turtle, *Chelonia mydas*. Proceedings of the 12th Annual Workshop on Sea Turtle Biology and Conservation. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SEFSC-361:158-161.

Balazs, G. H., S. G. Pooley, and S. K. K. Murakawa. 1995. Guidelines for handling marine turtles hooked or entangled in the Hawaii longline fishery: Results of an expert workshop held in Honolulu, Hawaii, March 15-17, 1995. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-222, 41 p.

Balazs, G. H., P. Siu, and J. P. Landret. 1995. Ecological aspects of green turtles nesting at Scilly Atoll in French Polynesia. Proceedings of the 12th Annual Workshop on Sea Turtle Biology and Conservation. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SEFSC-361:7-10.

Ballance, L. T. 1995. Flight energetics of free-ranging Red-footed Boobies, *Sula sula*. Physiol. Zoo. 68(5):887-914.

Barlow, J. 1995. The Abundance of Cetaceans in California Coastal Waters: I. Ship Surveys in Summer/Fall 1991. Fish. Bull., U.S. 93:1-14.

Barlow, J., R. L. Brownell, Jr., D. P. DeMaster, D. A. Forney, M. S. Lowry, S. Osmek, T. J. Ragen, R. R. Reeves, and R. J. Small. 1995. U.S. Pacific marine mammal stock assessments, U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-219, 162 p.

Barlow, J., and D. Hanan. 1995. An assessment of the status of harbor porpoise populations in California. Rep. int. Whal. Commn. Spec. Iss. 16:123-140.

Barlow, J., S. Swartz, T. Eagle, and P. R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-OPR-6, 73p.

Becker, B. L., D. E. O'Brien, K. B. Lombard, and L. P. Laniawe. 1995. The Hawaiian monk seal on Laysan Island, 1991. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-214, 16 p.

Bence, J. R. 1995. Analysis of short time series: Correcting for autocorrelation. Ecology 76(2):628-639.

Benetti, D. D., R. W. Brill, and S. A. Kraul, Jr. 1995. The standard metabolic rate of dolphin fish. J. Fish. Biol. 46(6):987-996.Bernard, H. J., and S. B. Reilly. 1995. The pilot whales, *Globicephala* sp. *In* S. Ridgway and R. Harrison (eds.), Handbook of Marine Mammals, Vol 6. Academic Press, Orlando, Florida.

Bjorndal, K. A., A. B. Bolten, A. L. Coan, Jr., and P. Kleiber. 1995. Estimation of green turtle (*Chelonia mydas*) growth rates from length-frequency analysis. Copeia 1995(1):71-77.

Botsford, L., J. P. Castello, G. Esqueda, J. Field, A. Garcia, Y. A. Green, H. Nakata, P. E. Smith, and P. T. Strub. 1995. Retention and transportation processes. *In* J. R. Hunter and J. Alheit (eds.), International GLOBEC Small Pelagic Fishes and Climate Change program. Report of the First Planning Meeting, La Paz, Mexico, June 20-24, 1994, p. 30-35. GLOBEC Report #8. 72 p.

Bowen, B. W., F. A. Abreu-Grobois, G. H. Balazs, N. Kamezaki, C. J. Limpus, and R. J. Ferl. 1995. Trans-Pacific migrations of the loggerhead turtle (*Caretta caretta*) demonstrated with mitochondrial DNA markers. Proc. Natl. Acad. Sci. USA 92:3731-3734.

Brill, R. W., G. H. Balazs, K. N. Holland, R. K. C. Chang, S. Sullivan, and J. C. George. 1995. Daily movements, habitat use, and submergence intervals of normal and tumor-bearing juvenile green turtles (*Chelonia mydas* L.) within a foraging area in the Hawaiian islands. J. Exp. Mar. Biol. Ecol. 185:203-218.

Brownell, R. L., Jr. 1995. Japanese-Soviet exploitation of pygmy blue whales. IBI Reports 5:25-29.

Brownell, R. L., Jr. 1995. Whaling error. Nature 375:272.

Brownell, R. L., Jr., K. Ralls, and W. F. Perrin. 1995. Marine mammal biodiversity: three diverse orders encompass 119 Species. Oceanus 38(2):30-33.

Carretta, J. V., K. A. Forney, and J. Barlow. 1995. Report of 1993-1994 marine mammal aerial surveys conducted within the U.S. Navy outer sea test range off southern California. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-217, 90 p.

Churnside, J. H., K. Bliss, R. Dotson, and R. Lynn. 1995. Data report: *In situ* data from 1994 lidar cruise of R/V *David Starr Jordan*. NOAA Data Report, Boulder, Colorado, ERL-ETL-5, 53 p.

Cury, P., C. Roy, R. Mendelssohn, A. Bakun, D. M. Husby, and R. H. Parrish. 1995. Moderate is better: exploring nonlinear climatic effects on the California northern anchovy (*Engraulis mordax*). *In* R. J. Beamish (ed.), Climate change and northern fish populations, p. 417-424. Can. Spec. Publ. Fish. Aquat. Sci. 121.

Demer, D. A., and R. P. Hewitt. 1995. Bias in acoustic biomass estimates of *Euphausia superba* due to diel vertical migration. Deep-Sea Res. I 42(4):455-475.

Demer, D. A., and L. V. Martin. 1995. Zooplankton target strength: volumetric or areal dependence? J. Acoust. Soc. Am. 98(2):1111-1118.

Dizon, A. E., P. J. Clapham, W. F. Perrin, and R. L. Brownell, Jr. 1995. Whaling dispute continues. Nature 377:282.

Dizon, A. E., B. L. Taylor, and G. M. O'Corry-Crowe. 1995. Why statistical power is necessary to link analyses of molecular variation to decisions about population structure, pp. 288-294. *In* J. L. Nielsen (ed.), Evolution and the Aquatic Ecosystem: Defining unique units in population conservation. American Fisheries Society Symposium 17.

Dutton, P., and G. H. Balazs. 1995. Simple biopsy technique for sampling skin for DNA analysis of sea turtles. Mar. Turt. Newsl. 69:9-10.

Eldridge, M. B., and B. M. Jarvis. 1995. Temporal and spatial variations in fecundity of yellowtail rockfish. Trans. Am. Fish. Soc. 124(1):16-25.

Ellis, D. M., and E. E. DeMartini. 1995. Evaluation of a video camera technique for indexing abundances of juvenile pink snapper, *Pristipomoides filamentosus*, and other Hawaiian insular shelf fishes. Fish. Bull., U.S. 93:67-77.

Forney, K. A. 1995. A decline in the abundance of harbor porpoise, *Phocoena phocoena*, in nearshore waters off California, 1986-93. Fish. Bull., U.S. 93:741-748.

Forney, K. A., J. Barlow, and J. Carretta. 1995. The abundance of cetaceans in California coastal waters. Part II: Aerial surveys in winter and spring of 1991 and 1992. Fish. Bull., U.S. 93:15-26.

Freese, S., J. Glock, and D. Squires. 1995. Direct allocation of resources and cost-benefit analysis in fisheries. Mar. Pol. 19(3):199-211.

Gerrodette, T. 1995. The ability of IDCR cruises to detect changes in blue whale population size. Rep. int. Whal. Commn. 45:271-272.

Gerrodette, T., L. A. Fleischer, H. Pérez-Cortés, and B. Villa Ramírez. 1995. Distribution of the vaquita, *Phocoena sinus*, based on sightings from systematic surveys. Rep. int. Whal. Commn. Spec. Iss. 16:273-281.

Graczyk, T. K., A. A. Aguirre, and G. H. Balazs. 1995. Detection by ELISA of circulating anti-blood fluke (*Carettacola, Hapalotrema,* and *Learedius*) immunoglobulins in Hawaiian green turtles (*Chelonia mydas*). J. Parasitol. 81(3):416-421.

Greene, H. G., M. M. Yoklavich, D. Sullivan, and G. M. Cailliet. 1995. A geophysical approach to classifying marine benthic habitats: Monterey Bay as a model. Alaska Dep. Fish and Game Special Publication Series No. 9:15-30.

Hassett, R. P., and G. W. Boehlert. 1995. Seasonal vertical, and horizontal distribution of four species of copepods around Oahu, Hawaii: Data Report. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-215, 21 p.

Hayward, T., D. Cayan, P. Franks, R. Lynn, A. Mantyla, J. McGowan, P. Smith, and F. Schwing. 1995. The state of the California Current 1994-1995; a period of transition. Calif. Coop. Oceanic Fish. Invest. Rep. 36:19-39.

Hobson, E. S., J. R. Chess, and D. F. Howard. 1995. Anomalous damage inflicted by Hurricane Iniki on a Hawaiian coral reef. Bull. Mar. Sci. 57(2):495-500.

Hopkins, T. E., M. B. Eldridge, and J. J. Cech, Jr. 1995. Metabolic costs of viviparity in yellowtail rockfish, *Sebastes flavidus*. Environ. Biol. Fishes 43:77-84.

Hunter, J. R., and J. Alheit (eds.). 1995. International GLOBEC Small Pelagic Fishes and Climate Change program. Report of the First Planning Meeting, La Paz, Mexico, June 20-24, 1994, GLOBEC Report #8. 72 p.

Jacobson, L. D., and A. D. MacCall. 1995. Stock-recruitment models for Pacific sardine. Can. J. Fish. Aquat. Sci. 52:566-577.

Johanos, T. C., L. M. Hiruki, and T. J. Ragen. 1995. The Hawaiian monk seal in the Northwestern Hawaiian Islands, 1992. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-216, 128 p.

Kirkley, J. E., D. Squires, and I. E. Strand. 1995. Assessing technical efficiency in commercial fisheries: the mid-Atlantic sea scallop fishery. Amer. J. Agr. Econ. 77:686-697.

Kobayashi, D. R., and K. E. Kawamoto. 1995. Evaluation of shark, dolphin, and monk seal interactions with Northwestern Hawaiian Island bottomfishing activity: a comparison of two time periods and an estimate of economic impacts. Fish. Res. 23:11-22.

Kope, R. G. 1995. Salmon management in the 21st century: Recovering stocks in decline. AFS Proceedings of the 1992 Northeast Pacific Chinook and Coho Workshop, Boise, Idaho, September 28-30, 1992, p. 214.

Kope, R. G., and L. W. Botsford. 1995. The winter run chinook salmon: Ready to reclaim the Sacramento River? U.S. Fish and Wildlife Service, Tideline 14(4):2-5.

Laidig, T. E., P. B. Adams, C. H. Baxter, and J. L. Butler. 1995. Feeding on euphausiids by *Octopus rubescens*. Calif. Fish Game 8(2):77-79.

Laidig, T. E., and S. Ralston. 1995. The potential use of otolith characters in identifying larval rockfish (*Sebastes* spp.) Fish. Bull., U.S. 93:166-171.Lenarz, W. H., D. VenTresca, W. M. Graham, F. B. Schwing, and F. Chavez. 1995. Explorations of el niños and associated biological population dynamics off central California. Calif. Coop. Oceanic Fish. Invest. Rep. 36:106-119.

Lo, N. C. H., P. E. Smith, and J. L. Butler. 1995. Population growth of northern anchovy and Pacific sardine using stage-specific matrix models. Mar. Ecol. Prog. Ser. 127:15-26.

Lynn, R. J., F. B. Schwing, and T. L. Hayward. 1995. The effect of the 1991-93 ENSO on the California Current System. Calif. Coop. Oceanic Fish. Invest. Rep. 36:57-71.

MacFarlane, R. B., and M. J. Bowers. 1995. Matrotrophic viviparity in the yellowtail rockfish *Sebastes flavidus*. J. Exp. Biol. 198:1197-1206.

Mason, J. E. 1995. Species trends in sport fisheries, Monterey Bay, Calif., 1959-86. Mar. Fish. Rev. 57:1-16.

Matsuura, Y., and R. Hewitt. 1995. Changes in the spatial patchiness of Pacific mackerel, *Scomber japonicus*, larvae with increasing age and size. Fish. Bull., U.S. 93:172-178.

Moisan, J., L. Botsford, and L. Jacobson. 1995. Process modeling. *In* J. R. Hunter and J. Alheit (eds.), International GLOBEC Small Pelagic Fishes and Climate Change program. Report of the First Planning Meeting, La Paz, Mexico, June 20-24, 1994, p. 52-54. GLOBEC Report #8. 72 p.

Norton, E. C., and R. B. MacFarlane. 1995. Nutritional dynamics of reproduction in viviparous yellowtail rockfish (*Sebastes Flavidus*). Fish. Bull., U.S. 93:299-307.

Ohman, M. D., and P. E. Smith. 1995. A comparison of zooplankton sampling methods in the CalCOFI time series. Calif. Coop. Oceanic Fish. Invest. Rep. 36:153-158.

Changes in macrozooplankton sampling methods over the course of the CalCOFI time series (1949-pre-

sent) are reviewed. After 1951, two major changes occurred: sampling depths were extended from 140 m to 210 m in 1969, and the 1.0-m-diameter bridled ring net was replaced with a 0.71-m-diameter bridleless bongo net in late 1977. The authors compare how these two changes affected the efficiency of collecting zooplankton biomass. Conversion factors between these sampling methods are provided, supplemented by a description of the nonlinear relationship between wet and dry zooplankton biomass in the California Current system.

Okechi, J. K., and J. J. Polovina. 1995. An evaluation of artificial shelters in the artisanal spiny lobster fishery in Gazi Bay, Kenya. S. Afr. J. Mar. Sci. 16:373-376.

Two designs of artificial shelters were evaluated for use in the artisanal spiny lobster fishery in Gazi Bay, Kenya. Both types of shelter were effective in aggregating the spiny lobster *Panulirus ornatus* in nearshore seagrass beds. Lobsters aggregated at the shelters were caught by free-diving fishermen, using spearguns and hand nets. Mean lobster catches taken from the shelters ranged from 0.38 to 0.83 $kgtrip^{-1}$, around 50% of those taken farther offshore in natural reefs. No significant difference was found in the size or sex composition between shelter and reef-caught lobsters.

Papadi, G. P., G. H. Balazs, and E. R. Johnson. 1995. Flow cytometric DNA content analysis of fibropapillomas in green turtles (*Chelonia mydas*). Dis. Aquat. Org. 22:13-18.

Parrish, R. H., and D. L. Mallicoate. 1995. Variation in the condition factors of California pelagic fishes and associated environmental factors. Fish. Oceanogr. 4(2):171-190.

Pearson, D. E., and G. Almany. 1995. The effectiveness of California's commercial rockfish port sampling program. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-218, 50 p.

Perrin, W. F., W. A. Armstrong, A. N. Baker, J. Barlow, S. R. Benson, A. S. Collet, J. M. Cotton, D. M. Everhart, T. D. Farley, R. M. Mellon, S. K. Miller, V. Philbrick, J. L. Quan, and H. R. L. Rodriguez. 1995. An anomalously pigmented form of the short-beaked common dolphin (*Delphinus delphis*) from the southwestern Pacific, eastern Pacific and eastern Atlantic. Mar. Mamm. Sci. 11(2):241-147.

Pitman, R. L., L. B. Spear, and M. P. Force. 1995. The marine birds of Malpelo Island, Colombia. Colon. Waterbirds 18(1):113-119.

Polovina, J. J., W. R. Haight, R. B. Moffitt, and F. A. Parrish. 1995. The role of benthic habitat, oceanography, and fishing on the population dynamics of the spiny lobster (*Panulirus marginatus*) in the Hawaiian Archipelago. Crustaceana 68(2):203-212.

Polovina, J. J., G. T. Mitchum, and G. T. Evans. 1995. Decadal and basin-scale variation in mixed layer depth and the impact on biological production in the Central and North Pacific, 1960-88. Deep-Sea Res. 42(10):1701-1716.

Polovina, J. J. and R. B. Moffitt. 1995. Spatial and temporal distribution of the phyllosoma of the spiny lobster, *Panulirus marginatus*, in the Northwestern Hawaiian Islands. Bull. Mar. Sci. 56:406-417.

Rabour, C. O., and J. J. Polovina. 1995. An analysis of the multigear, multispecies fishery in the Kenyan waters of Lake Victoria. Naga 18(2):34-37.

Ragen, T. J., G. A. Antonelis, and N. Kiyota. 1995. The early phase of northern fur seal pup migration from St. Paul Island, Alaska. J. Mammal. 76:1137-1148.

Ralston, S. 1995. The influence of oceanographic variables on time series of otolith growth in pelagic young-of-the-year rockfish, *Sebastes* spp. *In* D. H. Secor, J. M. Dean, and S. E. Campana (eds.), Recent developments in fish otolith research, p. 97-118. University of South Carolina Press.

Ralston, S., and D. F. Howard. 1995. On the development of year-class strength and cohort variability in two northern California rockfishes. Fish. Bull., U.S. 93:710-720.

Ramp, S. R., N. Garfield, C. A. Collins, L. K. Rosenfeld, and F. B. Schwing. 1995. Circulation studies over the Continental Shelf and slope near the Farallon Islands, CA, Executive Summary. Technical Report NPS-OC-95-004, 40 p.

Robeck, T. R., B. E. Curry, J. F. McBain, and D. C. Kraemer. 1995. Reproductive biology of the bottlenose dolphin (*Tursiops truncatus*) and the potential application of advanced reproductive technologies. J. Zoo. Wildl. Med. 25(3):321-336.

Rogers, J. B. 1995. *Sebastes* complex assessment methodology. Appendix D. *In* Status of the Pacific Coast Groundfish Fishery through 1995 and recommended acceptable biological catches for 1996. Pacific Fishery Management Council, Portland, Oregon.

Rosel, P. E., M. G. Haygood, and A. E. Dizon. 1995. Mitochondrial control region variability in populations of the harbour porpoise, *Phocoena phocoena*, on interoceanic and regional scales. Can. J. Fish. Aquat. Sci. 52:1210-1219.

Rosel, P. E., M. G. Haygood, and W. F. Perrin. 1995. Phylogenetic relationships among the true porpoises (Cetacea: Phocoenidae). Mol. Phylogenetics Evol. 4(4):463-474.

Sakagawa, G. T. (ed.) 1995. Assessment methodologies and management. Proceedings of the World Fisheries Congress, Theme 5. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 195 p.

Sakuma, K. M., and T. E. Laidig. 1995. Description of larval and pelagic juvenile chilipepper, *Sebastes goodei* (family Scorpaenidae), with an examination of larval growth. Fish. Bull., U.S. 93:721-731.

Sakuma, K. M., and R. J. Larson. 1995. Distribution of pelagic metamorphic-stage sanddabs *Citharichthys sordidus* and *C. stigmaeus* within areas of upwelling off central California. Fish. Bull., U.S. 93:516-529.

Sakuma, K. M., and S. Ralston. 1995. Distributional patterns of late larval groundfish off central California in relation to hydrographic features during 1992 and 1993. Calif. Coop. Oceanic Fish. Invest. Rep. 36:179-192.

Sakuma, K. M., F. B. Schwing, H. A. Parker, K. Baltz, and S. Ralston. 1995. The physical oceanography off the central California coast during March and May-June, 1994: a summary of CTD data from larval and pelagic juvenile rockfish surveys. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-221, 202 p.

Sakuma, K. M., F. B. Schwing, H. A. Parker, and S. Ralston. 1995. The physical oceanography off the central California coast during February and May-June, 1991: a summary of CTD data from larval and pelagic juvenile rockfish surveys. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-220, 156 p.

Salvanes, K. G., and D. Squires. 1995. Transferable quotas, enforcement costs and typical firms: an empirical application to the Norwegian trawler fleet. Environ. Resource Econ. 6:1-12.

Smith, P.E. 1995. A warm decade in the Southern California Bight. Calif. Coop. Oceanic Fish. Invest. Rep. 36:120-126.

Smith, P.E. 1995. Development of the population biology of the Pacific hake, *Merluccius productus*. Calif. Coop. Oceanic Fish. Invest. Rep. 36:144-152.

Somerton, D. A., and B. S. Kikkawa. 1995. A stock survey technique using the time to capture individual fish on longlines. Can. J. Fish. Aquat. Sci 52:260-267.

Squires, D., and J. Kirkley. 1995. Resource rents from single and multispecies individual transferable quota programs. ICES J. mar. Sci. 52:153-164.

Squires, D., J. Kirkley, and C. A. Tisdell. 1995. Individual transferable quotas as a fisheries management tool. Rev. of Fish. Sci. 3(2):141-169.

Taylor, B. L. 1995. The reliability of using population viability analysis for risk classification of species. Conserv. Biol. 9(3):551-558.

Taylor, B. L., and J. Barlow. 1995. The step-wise fit: a new model for estimating mammalian mortality from incomplete data sets. *In* J. D. Ballou, M. Gilpin, and T. J. Foose (eds.), Population management for survival and recovery: Analytical methods and strategies in small population conservation, p. 24-43. Columbia University Press, New York. 375p.

Taylor, B. L., T. B. Gage, J. Barlow, P. Mamelka, and B. Dyke. 1995. Mortality models for numerically small populations of mammals. *In* J. D. Ballou, M. Gilpin, and T. J. Foose (eds.), Population management for survival and recovery: Analytical methods and strategies in small population conservation, p. 44-54. Columbia University Press, New York. 375p.

Townsend, R. E., and S. G. Pooley. 1995. Distributed governance in fisheries. *In* S. Hanna and M. Munasinghe (eds.), Property rights in a social and ecological context: Case studies and design applications, p. 47-58. Beijer International Institute of Ecological Economics, Stockholm, Sweden, and The World Bank, Washington, D.C.

Townsend, R. E., and S. G. Pooley. 1995. Distributed governance in the Northwestern Hawaiian Islands lobster fishery. *In* S. Hanna and M. Munasinghe (eds.), Property rights in a social and ecological context: Case studies and design applications, p. 33-39. Beijer International Institute of Ecological Economics, Stockholm, Sweden, and The World Bank, Washington, D.C.

Townsend, R. E., and S. G. Pooley. 1995. Fractional licenses: an alternative to license buy-backs. Land Econ. 71(1):141-143.

VenTresca, D. A., R. H. Parrish, J. L. Houk, N. L, Gingras, S. D. Short, and N. L. Crane. 1995. El Niño effects on the somatic and reproductive condition of blue rockfish (*Sebastes mystinus*). Calif. Coop. Oceanic Fish. Invest. Rep. 3:167-174.

Wade, P. R. 1995. Revised estimates of incidental kill of dolphins (Delphinidae) by the purse-seine tuna fishery in the eastern tropical Pacific, 1959-1972. Fish. Bull., U.S. 93:345-354.

Woodbury, D., A. Babcock Hollowed, and J. A. Pearce. 1995. Interannual variation in growth rates and back-calculated spawn dates of juvenile Pacific hake (*Merluccius productus*). *In* D. H. Secor, J. M. Dean, and S. E. Campana (eds.), Recent developments in fish otolith research, p. 481-496. University of South Carolina Press.

The coastal stock of Pacific hake (*Merluccius productus*) exhibits large variations in year-class strength. Adjacent year-classes may vary tenfold to thirtyfold in abundance. Larval and juvenile Pacific hake inhabit the coastal waters off California, where the oceanic environment is highly variable. The daily growth and spawn-date distributions of juvenile Pacific hake collected along the central California coast during years of high and low juvenile abundance are described. Growth rates and back-calculated spawn-date distributions of young-of-the-year Pacific hake were estimated from an analysis of otolith daily growth increments from juveniles collected in 1987, 1988, 1991, and 1992. The abundance of juvenile Pacific hake was higher in 1987-88 than in 1991-92. There were significant interannual variations in mean growth rates and mean spawn dates. Growth was faster and spawn dates earlier in 1987-88, compared with the slower growth and later spawn dates observed in 1991-92. These findings are consistent with earlier studies that indicate events occurring during the early life-history

determine the magnitude of year-class strength for this species.

Yoklavich, M. M., G. M. Cailliet, H. G. Greene, and D. Sullivan. 1995. Interpretation of side-scan sonar records for rockfish habitat analysis: examples from Monterey Bay. Alaska Dep. Fish and Game Special Publication Series No. 9:11-14.

Zug, G. R., G. H. Balazs, and J. A. Wetherall. 1995. Growth in juvenile loggerhead sea turtles (*Caretta caretta*) in the North Pacific pelagic habitat. Copeia 1995(2):484-487.

Published in First Quarter 1996

Alam, M. F., I. H. Omar, and D. Squires. 1996. Sustainable resource use, economic development, and public regulation: The multiproduct gill net fishery of peninsular Malaysia. Envir. Res. Econ. 7:117-132.

The role of production technology for sustainable economic growth and resource management in the multispecies renewable resources industries is a neglected issue, particularly in complex tropical ecosystems. Given the still rudimentary understanding of biological interactions among species, even in most temperate ecosystems, the importance of understanding the technological and economic interactions is heightened for sustainable economic growth and public regulation. These interactions for the multiproduct gill net fisheries of Peninsular Malaysia are evaluated. Standard price and quantity controls may have little promise. Gear regulations, a policy of constant escapement, and managing the entire mix of species as a single stock for economic rather than biomass yield appear the most promising management tools given the limited regulatory options.

Bailey, K., A. Brown, M. Yoklavich, and K. Mier. 1996. Interannual variability in growth of larval and juvenile walleye pollock *Theragra chalcogramma* in the western Gulf of Alaska, 1983-91. Fish. Oceanogr. 5 (Suppl. 1), 137-147.

Ballance, L. T., R. L. Pitman, S. B. Reilly, and M. P. Force. 1996. Report of a cetacean, seabird, marine turtle and flyingfish survey of the western tropical Indian Ocean aboard the research vessel *Malcolm Baldrige*, March 21 – July 26, 1995. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-224, 132 p.

Barry, J. P., M. M. Yoklavich, G. M. Cailliet, D. A. Ambrose, and B. S. Antrim. 1996. Trophic ecology of the dominant fishes in Elkhorn Slough, California, 1974-1980. Estuaries 19:115-138.

Bence, J. R., A. Stewart-Oaten, and S. C. Schroeter. 1996. Estimating the size of an effect from a Before-After-Control-Impact-Pairs design: The predictive approach applied to a power plant study. *In* R. J. Schmitt and C. W. Osenberg (eds.), Detecting ecological impacts: Concepts and applications in coastal habitats, p. 133-149. Academic Press, San Diego, California.

Brownell, R. L., Jr. 1996. Hawaiian monk seals: past, present and future. IBI Reports 6:35-41.

Butler, J. L., K. A. Dahlin, and H. G. Moser. 1996. Growth and duration of the planktonic phase and a stage based population matrix of Dover sole, *Microstomus pacificus*. Bull. Mar. Sci. 58(1):29-43.

Curran, D. S., C. H. Boggs, and X. He. 1996. Catch and effort from Hawaii's longline fishery summarized by quarters and five degree squares, 1991-1994. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-225, 68 p.

Gilpatrick, J. W., Jr. 1996. Calibration of radar altimeter readings used in aerial photogrammetry of eastern tropical Pacific dolphins—1992 and 1993. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-226, 23 p.

Johanos, T. C., and T. J. Ragen (eds.). 1996. The Hawaiian monk seal in the Northwestern Hawaiian Islands, 1993. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-227, 141 p.

Lowry, M. S., W. L. Perryman, M. S. Lynn, and R. Westlake. 1996. Counts of northern elephant seals (*Mirounga angustirostris*) from large-format aerial photographs taken at rookeries in Southern California during the breeding season. Fish. Bull., U.S. 94:176-185.

Parrish, R. H. 1996. Lanternfish heaven: the future of world fisheries. NAGA-ICLARM Quarterly 18(3):7-9.

Yaremko, M. L. 1996. Age determination in Pacific sardine, *Sardinops sagax*. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-223, 30 p.

Approved by Science and Research Director, SWR

This list is for those publications approved by the Science and Research Director in January-March 1996 for all laboratories.

Au, D. W., and S. E. Smith. A demographic method with population density compensation for estimating productivity and yield per recruit of the leopard shark, *Triakis semifasciata*. For consideration for publication in Canadian Journal of Fisheries and Aquatic Sciences.

Ballance, L. T., R. L. Pitman, and S. B. Reilly. Seabird community structure along a productivity gradient: importance of competition and energetic constraint. For consideration for publication in Ecology.

Bigelow, K. A., R. N. Nishimoto, R. M. Laurs, and J. A. Wetherall. Validated age and growth models for North Pacific albacore tuna (*Thunnus alalunga*). For consideration for publication in Marine Biology.

Butler, J. L., M. L. Granados G., J. T. Barnes, M. Yaremko, and B. J. Macewicz. Age composition, growth and maturation of the Pacific sardine, *Sardinops sagax*, dur-

ing 1994. For consideration for publication in California Cooperative Oceanic Fisheries Investigations Reports.

Deriso, R. B., J. T. Barnes, L. D. Jacobson, and P. Arenas. Catch-at-age analysis for Pacific sardine (*Sardinops sagax*), 1983-1995. For consideration for publication in California Cooperative Oceanic Fisheries Investigations Reports.

Edwards, E. F., and P. C. Perkins. Estimated tuna discard from dolphin, school and log sets in the eastern tropical Pacific Ocean: 1989-1992. For consideration for publication in Fishery Bulletin, U.S.

Kleiber, P., and N. Bartoo. Standardizing catch per unit effort of swordfish in the Pacific-wide Japanese longline fleet using general additive models. For consideration for publication in Fishery Bulletin, U.S.

Kretzmann, M. B., W. G. Gilmartin, A. Meyer, G. P. Zegers, S. R. Fain, B. E. Taylor, and D. P. Costa. Low genetic variability in the Hawaiian monk seal: conservation implications. For consideration for publication in Conservation Biology.

McKinnell, S., and M. P. Seki. Shark bycatch in the Japanese high seas squid driftnet fishery in the North Pacific Ocean. For consideration for publication in Fisheries Research.

Parrish, R. H. Laternfish heaven and the future of world fisheries. For consideration for publication in NAGA-ICLARM Quarterly.

Pitman, R. L., and C. A. LeDuc. The Masked Boobies of Clipperton Island: extraordinary recovery of a decimated population and evidence for two separate species. For consideration for publication in Auk.

Vidal, O., J. Barlow, L. A. Hurtado, J. Torre, P. Cendón, and Z. Ojeda. Distribution and abundance of the buffeo colorado (*Inia geoffrensis*) and the tucuxi (*Sotalia fluviatilis*) in the upper Amazon River. For consideration for publication in Marine Mammal Science.

Administrative Reports

Administrative Reports are strictly for internal use only and are not to be cited or treated as publications.

Honolulu

Aguirre, A. A., and T. R. Spraker. 1995. Pathology associated with cardiovascular trematodes and fibropapillomas in green turtles (*Chelonia mydas*) from the Hawaiian Islands. SWFSC Admin. Rep., Honolulu, H-95-01C, 20 p.

Dollar, R. A. 1995. Annual report of the 1994 western Pacific lobster fishery. SWFSC Admin. Rep., Honolulu, H-95-06, 33 p.

Haight, W. R., and G. T. DiNardo. 1995. Status of lobster stocks in the Northwestern Hawaiian Islands. SWFSC Admin. Rep., Honolulu, H-95-03, 17 p.

Hamm, D. C., M. M. C. Quach, L. M. K. So, and N. T. S. Chan. 1995. Fishery statistics of the western Pacific, Volume X. SWFSC Admin. Rep., Honolulu, H-95-05, 165 p.

Ito, R. Y. 1995. Annual report of the 1994 Hawaii-based longline fishery. SWFSC Admin. Rep., Honolulu, H-95-08, 36 p.

Kawamoto, K. E. 1995. Northwestern Hawaiian Islands bottomfish fishery, 1994. SWFSC Admin. Rep., Honolulu, H-95-07, 26 p.

Wetherall, J. A., W. R. Haight, and G. T. DiNardo. 1995. Computation of the preliminary 1995 catch quota for the Northwestern Hawaiian Islands lobster fishery. SWFSC Admin. Rep., Honolulu, H-95-04, 35 p.

La Jolla

Armstrong, W. A., and C. W. Oliver. 1995. Recent use of fish aggregating devices in the eastern tropical Pacific tuna purse-seine fishery: 1990-1994. SWFSC Admin. Rep., La Jolla, LJ-95-14, 47 p.

Butler, J. L., C. Kastelle, K. Rubin, D. Kline-Henk Heijinis, L. Jacobson, A. Andrews, and W. W. Wakefield. 1995. Age determination of shortspine thornyhead, *Sebastolobus alascanus*, using otolith sections and ^{210}Pb:^{226}Ra ratios. SWFSC Admin. Rep., La Jolla, LJ-95-12, 21 p.

Childers, J., and F. R. Miller. 1995. Summary of the 1994 U.S. North and South Pacific albacore troll fisheries. SWFSC Admin. Rep., La Jolla, LJ-95-15, 57 p.

Coan, A. L., Jr., D. Prescott, and G. Yamasaki. 1995. The 1994 U.S. purse seine fishery for tropical tunas in the western pacific ocean. SWFSC Admin. Rep., La Jolla, LJ-95-10, 13 p.

Edwards, E. F. 1995. Second dolphin-safe research planning workshop: March 14-17, 1994 report and recommendations. SWFSC Admin. Rep., La Jolla, LJ-95-05, 46 p.

Edwards, E. F. 1995. Summary of U.S. tuna purse-seine fleet characteristics as related to dolphin mortality in the eastern tropical Pacific Ocean, 1991-1994. SWFSC Admin. Rep., La Jolla, LJ-95-04, 13 p.

Farley, T. D. 1995. 1995. Geographic variation in dorsal fin color of short-beaked common dolphins, *Delphinus delphis*, in the eastern Pacific Ocean. SWFSC Admin. Rep., La Jolla, LJ-95-06, 18 p.

Gerrodette, T., M. A. Donahue, S. R. Benson, K. F. Mangels, T. Lee, S. Keagy. 1995. Database of cetacean

photographs at the Southwest Fisheries Science Center. SWFSC Admin. Rep., La Jolla, LJ-95-07, 58 p.

Hunter, J. R., and J. H. Churnside (eds.). 1995. Airborne Fishery Assessment Technology—A NOAA workshop report. SWFSC Admin. Rep., La Jolla, LJ-95-02, 71 p.

Jacobson, L. D., N. C. H. Lo, S. F. Herrick, Jr., and T. Bishop. 1995. Spawning biomass of the northern anchovy in 1995 and status of the coastal pelagic fishery during 1994. SWFSC Admin. Rep., La Jolla, LJ-95-11, 49 p.

Mackett, D. J. (comp.) 1995. Current year operations plans for fiscal year 1995. SWFSC Admin. Rep., La Jolla, LJ-95-09, 291 p.

Myrick, A. C., Jr. 1995. Documentation of progress of stress research projects for future reference. SWFSC Admin. Rep., La Jolla, LJ-95-01, 14 p.

Rosenberg, J. 1995. AMLR 1994/95 field season report: Objectives, accomplishments and tentative conclusions. SWFSC Admin. Rep., La Jolla, LJ-95-13.

Scannell, C. L., T. Dickerson, P. Wolf, and K. Worcester. 1996. Application of an egg production method to estimate the spawning biomass of Pacific sardines off southern California in 1986. SWFSC Admin. Rep., La Jolla, LJ-96-01, 37 p.

Taylor., B. L. 1995. Defining "population" to meet management objectives for marine mammals. SWFSC Admin. Rep., La Jolla, LJ-95-03, 22 p.

Tillman, M. F. 1995. Director's report to the 46th tuna conference on tuna and tuna-related activities at the Southwest Fisheries Science Center for the period May 1, 1994, to April 30, 1995. SWFSC Admin. Rep., La Jolla, LJ-95-08, 9 p.

Tiburon

Adams, P. (ed.) and Staff of the Tiburon Laboratory. 1995. Progress in rockfish recruitment studies. SWFSC Admin. Rep., Tiburon, T-95-01, 51 p.

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